OECD Science, Technology and Industry Working Papers
2009/05

Who Licenses out Patents and Why? Lessons from a Business Survey

Maria Pluvia Zuniga,

Dominique Guellec

https://dx.doi.org/10.1787/224447241101

OECD

Unclassified **DSTI/DOC(2009)5**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **31-Mar-2009**

English - Or. English

DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY

DSTI/DOC(2009)5
Unclassified

WHO LICENSES OUT PATENTS AND WHY? LESSONS FROM A BUSINESS SURVEY

STI WORKING PAPER 2009/5
Statistical Analysis of Science, Technology and Industry

Maria Pluvia Zuniga and Dominique Guellec

English - Or. English

JT03262312

STI Working Paper Series

The Working Paper series of the OECD Directorate for Science, Technology and Industry is designed to make available to a wider readership selected studies prepared by staff in the Directorate or by outside consultants working on OECD projects. The papers included in the series cover a broad range of issues, of both a technical and policy-analytical nature, in the areas of work of the DSTI. The Working Papers are generally available only in their original language – English or French – with a summary in the other.

Comments on the papers are invited, and should be sent to the Directorate for Science, Technology and Industry, OECD, 2 rue André-Pascal, 75775 Paris Cedex 16, France.

The opinions expressed in these papers are the sole responsibility of the author(s) and do not necessarily reflect those of the OECD or of the governments of its member countries.

---

http://www.oecd.org/sti/working-papers

WHO LICENSES OUT PATENTS AND WHY? LESSONS FROM A BUSINESS SURVEY

Maria Pluvia Zuniga and Dominique Guellec

Economic Analysis and Statistics Division
Directorate for Science, Technology and Industry (DSTI), OECD
Contact: dominique.guellec@oecd.org

ABSTRACT

The increasing importance of licensing for innovation is supported by ample anecdotal evidence. However, statistics on this topic are scarce. The OECD, together with the European Patent Office and the University of Tokyo, carried out a business survey on the licensing-out of patents. The goal was to investigate the intensity of licensing to affiliated and non-affiliated companies, its evolution, the characteristics, motivations and obstacles met by companies doing or willing to license. The target population was patent holders: 600 European firms and 1 600 Japanese firms responded to the survey, in the second half of 2007. The results show that patent licensing is widespread among patenting firms: around one company in five in Europe licenses patents to non-affiliated partners, whereas more than one in four does so in Japan. The relationship between size of the firm and probability to license out is U-shaped: small firms and large firms are more likely to license out their patented inventions. In Europe, SMEs have more difficulties to license out their patents than large firms. The major barrier to licensing out patent markets is informational (identifying partners). Finally, we also find that more than one third of young European firms (born after 2000) deem patents as quite or very important to convince private investors and venture capitalists to provide them with funds.

Key words: patents, patent licensing, technology markets, Europe, Japan

JEL classification codes: D45, O32, O34

Acknowledgements: This study has benefited from methodological support by Claire Lelarge (OECD) and Peter Hingley from the European Patent Office (EPO) and from fruitful comments by participants at the EPO-OECD Conference on Patent Statistics for Decision Makers (Vienna, September 3-4, 2008), the Annual Conference of the European Policy for Intellectual Property Association, EPIP (Bern, October 3-4, 2008) and the 2008 Kauffman Symposium on Entrepreneurship and Innovation Data (Washington, November 21, 2008).

QUI LICENCIE DES BREVETS ET POURQUOI? ENSEIGNEMENTS D'UNE ENQUÊTE AUPRÈS DES ENTREPRISES

Maria Pluvia Zuniga et Dominique Guellec

Division des analyses économiques et des statistiques
Direction de la science, de la technologie et de l'industrie (DSTI), OCDE
Contact: dominique.guellec@oecd.org

RÉSUMÉ

L'importance accrue des licences de brevets pour l'innovation est attestée par nombre d'anecdotes. Cependant, les statistiques sur ce domaine sont rares. L'OCDE, en partenariat avec l'Office européen des brevets et l'Université de Tokyo, a conduit une enquête sur les licences de brevets. L'objectif était de mesurer l'intensité de l'activité de licence avec les entreprises affiliées et non-affiliées (indépendantes), son évolution, ses caractéristiques, ses motivations et les obstacles rencontrés par les entreprises qui souhaitent licencier. La population couverte comprend les titulaires de brevet: 600 entreprises européennes et 1 600 entreprises japonaises ont répondu à l'enquête, conduite dans la seconde moitié de 2007. Les réponses montrent que les licences de brevets sont très courantes parmi les entreprises titulaires de brevets: environ une entreprise sur cinq en Europe, et plus d'une sur quatre au Japon, licencient des brevets à des partenaires indépendants. La relation entre taille de l'entreprise et probabilité de licencier est en forme de U: les petites entreprises et les grandes ont une plus grande propension à licencier leurs brevets. En Europe, les petites et moyennes entreprises rencontrent plus d'obstacles que les grandes lorsqu'elles souhaitent licencier. Le principal obstacle à la licence est d'ordre informationnel: identifier des partenaires. Finalement, on trouve aussi qu'un tiers des entreprises européennes nées après 2000 estiment que les brevets sont plutôt ou très importants pour convaincre les investisseurs et capital risqueurs de leur fournir des fonds.

Mots-clés: brevets, licences de brevets, marchés de la technologie, Europe, Japon

Codes de classification JEL: D45, O32, O34

Remerciements: Cette enquête a bénéficié du soutien méthodologique de Claire Lelarge (OCDE) et de Peter Hingley de l'Office européen des brevets (OEB) et des commentaires fructueux des participants à la conférence de l'OEB-OCDE sur les statistiques de brevets pour les décideurs (Vienne, 3-4 septembre 2008), la Conférence annuelle de l'EPIP (Berne, 3-4 octobre 2008) et le symposium Kauffman sur l'entreprenariat et les indicateurs d'innovation (Washington, 21 novembre 2008).

TABLE OF CONTENTS

1. BACKGROUND AND OBJECTIVES

A patent license is a contract by which the patent holder authorises another party to use its invention under certain conditions (notably financial). A market for technology refers to transactions for the use, diffusion and creation of technology (Arora *et al.,* 2001). This includes transactions involving patents and other intellectual property rights (IPR), know-how and patent licensing. It also includes transactions involving knowledge that is not patentable or not patented (*e.g.* software, or the many non-patented designs and innovations). Patent licensing plays a central role in technology markets. It frequently constitutes the pillar for knowledge exchange as patents can work as "credible hostages" when non-protected, complementary know-how and services are provided. This work aims at providing new evidence on the licensing of patents, its evolution and motivations, and on the obstacles companies face when attempting to commercialise patents in markets.

Abundant anecdotal evidence suggests that the volume and value of patent licensing has expanded over recent years. This phenomenon has been related to broad changes in the modes of innovation, globalisation and strengthened market competition (OECD 2006a). A new organisation of industrial research has emerged, less centred on the individual firm, more based on networks and markets, and relying more on new entrants and technology-based firms. Innovative firms are increasingly dependent on external sources of knowledge rather than conducting in-house research. Intensified competition, shorter product life-cycles and expanded technological opportunities force businesses to innovate more rapidly and focus their R&D expenditures, hence requiring privileged and rapid access to complementary new knowledge from the public and business sectors. Financial, regulatory (*e.g.* strengthening of intellectual property rights world wide) and organisational changes have further boosted technological transactions and fostered development of markets for technology that are often mediated by the exchange or sale of licenses for patented technologies.

From a social welfare perspective, licensing has many potentially positive effects. Licensing of patents increases the diffusion of technology, facilitates vertical specialisation and the division of tasks between companies and prevents R&D duplication in the economy. Licensing can boost downstream competition by reducing barriers to entry related to R&D. Returns from licensing can be in turn invested on further innovation by licensors. Finally, licensing facilitates the exploitation of a technology at a larger scale than if the patentee did it alone: licensing permits commercialisation of technologies across industries, on a larger geographical scale, in countries or regions where the patentee does not operate. Licensing can also have negative effects as it may be used as a collusion device between companies, hence reducing competition and in some cases, innovation. For instance, exclusive licensing is sometimes suspected of allowing the involved companies to lock out competitors and share markets. Therefore, both innovation policy authorities and competition authorities have a strong interest in monitoring licensing activity.

OECD has been gathering evidence on licensing over recent years (OECD 2006a and 2006b), but it is mainly anecdotal evidence. Little is known on licensing transactions from a quantitative perspective: their volume, the profile of companies involved, the sectors where they are more prevalent, the motives for the firms involved, their economic effects and the difficulties they meet with. Anecdotal evidence is available for all these questions, but no statistics. That is all the more detrimental in view of the apparently growing volume and importance of transactions involving technology. Businesses and governments need to have a

clear picture of the situation and identify possible institutional gaps that would deserve action. For that purpose, the OECD, with the European Patent Office ([EPO]; the survey was supervised by Peter Hingley, of the EPO Controlling Office) and the University of Tokyo (the survey was supervised by Professor Kazuyuki Motohashi; it benefited from a database provided by the Japan Patent Office [JPO]), have taken the initiative of conducting a business survey on the economic uses of patent, focusing in particular on the licensing-out.

The aim of the survey is to investigate the use of patents for licensing and raising capital: its development over recent years, its motivations, and its articulation with other practices of companies, its outcomes, and the obstacles it is confronted with; in addition, a few questions addressed the use of patents for raising capital. This document presents the results of the survey. It reports cross-tabulations of the responses, weighted for grossing them up to the target population (patent holders of EPO and JPO). Tabulations are complemented by a simple regression analysis so as to better control for the influence of various characteristics of the firms. All questions of the survey are analysed: licensing to affiliated and non-affiliated companies, willingness to license, collaborative practices (*e.g.* cross-licensing, clearing houses, etc.) and the financial uses of patents.

The major findings are as follows. Licensing-out of patents is widespread among patenting firms both in Europe and in Japan. Around one (patenting) company in five in Europe licenses patents to non-affiliated companies whereas more than one in four does so in Japan. The relationship between size and the firm and probability to license out is U-shaped: small firms on the one hand and large firms on the other hand are more likely to license out their patented inventions, while medium-sized companies are less likely to do it. In Europe, SMEs (small and medium companies) have more difficulties to license out their patents than large firms. The major barrier to licensing out patent markets is informational (identifying partners) and this obstacle is more important for SMEs.

This document is organised as follows. The next section reviews the economic literature on patent licensing. In the third section, we present the survey, and in the fourth we review the major findings. Finally, we conclude and draw some policy implications from the findings.

2. ECONOMIC FOUNDATIONS OF MARKETS FOR PATENTS

2.1. Economic motivations to licensing

The motivations to license technology are diverse. Traditional explanations for licensing build on the idea that firms license if they are less able (or unable) to exploit the innovation than the potential licensees, or they aim at establishing their technology as a *de facto* standard, for instance when network externalities are important. Licensing can be used strategically to influence competition and stimulate market demand. Shepard (1987) has shown that licensing can induce quality competition within providers and expand supply through licensing; which in turn, increases industry demand. Licensing is also motivated by the "choosing competitors" motivation, that is, to choose rivals after the patent expires and extend a dominant position (Rockett, 1990; *e.g.* generics in pharmaceuticals), or to deter new entrants from inventing competing products by offering them a license which is less costly than doing R&D (Gallini, 1984).

Licensing serves as well to leverage economic value from unused inventions, or expand the range of uses (markets) of a particular invention. For "fabless firms", specialised in R&D, licensing constitutes a major instrument to generate revenue from intellectual assets. It is also used as a tool for exchanging knowledge and to solve conflicts in intellectual property rights (IPR). Cross-licensing is helpful to overcome patent thickets and the problem of components that arises when multiple patent holders can block each other's market products (Shapiro, 2001a; Hall and Ziedonis, 2001). Licensing also occurs in the context of cumulative innovations where multiple patents are at play for the forward development of technology (Scotchmer, 1991). Constrained licensing is implemented by companies that credibly threaten to sue as they can deal with litigation costs and their chances of winning the dispute are higher (Shapiro, 2001b).

2.2. Factors affecting technology transactions

Markets for technologies are often viewed as being less efficient than common product markets. Licensing is a complex decision to take since it implies the sharing of rents of innovation with the licensee. For companies, a main worry constitutes the risk of imitation by the partner. In addition, contracting on technology is complex and costly. Writing and executing a reliable contract for the use of technology requires adequate specification of IPR and their use, monitoring, and enforcement of contractual terms, which are not straightforward tasks. Other transaction costs include the search of partners, the drafting of contracts, legal assistance, etc.

The difficulties in technology transactions have been attributed to a number of factors: the cognitive nature of the good (knowledge) which is difficult to articulate or transfer across contexts (*e.g.* Von Hippel, 1994), the characteristics of the industry or market affected by the technology in question (*i.e.* maturity, product life cycles, etc.), and the characteristics of the parties involved in transactions, etc. (Gambardella, 2002; Arora *et al.*, 2001). The problems of appropriability and indivisibility of knowledge, and uncertainty on the value of the technology (Arrow, 1962) make contracts incomplete. These aspects introduce moral hazard and information asymmetries which increase the risk of opportunism by partners (Williamson, 1991). Transactions in technology are also affected by the difficulties in exchanging tacit knowledge (specific context: *e.g.* know-how that is necessary to develop technology, Arora, 1995), which is difficult to define in a contract. On the contrary, knowledge that is codified (articulated following a model or methodology, scientific principles, etc.) and general is easier to transfer (Arora and Gambardella, 1994).

Protection of IPR is a major element in the incentives to commercialise technology as it permits to deal with the appropriability problem. The literature argues that, in certain contexts, the strength of patent protection may positively influence the decision to license technologies. Stronger protection reduces the risk of opportunistic behaviour by the licensee (Merges, 1998; Arora and Merges, 2004) and reinforces the licensor's bargaining power, which enables him to appropriate a larger share of the total surplus generated by the licensing deal. In the empirical literature there is evidence that stronger patents reduce transaction costs in technology licensing contracts and favour vertical specialisation. In an empirical study of 1 365 licensing contracts, Anand and Khanna (2000) find that, in industries where IPR are important, licensing of patents tends to be higher (chemicals and pharmaceuticals).[1] In an empirical study of 11 839 alliances, Vonortas and Kim (2004) find that a strong intellectual protection in the primary line of business of the licensor has a positive impact on his/her propensity to engage in licensing agreements. Nagaoka (2005) finds that stronger protection of IPR in Japan looks to have increased the frequency of high-royalty contracts in the later part of the 1990s in the Japanese industries for which a patent is important for

1. They show that 80% of licensing deals are made in chemicals-pharmaceuticals (46%), electric equipment and electronics (22%) and materials and industrial equipment (12%). This proportion is weaker for computers and electronics, where protection is of less magnitude and alliances take the form more of joint ventures or cross-licensing (frequently as a result of litigation).

appropriability. Gambardella *et al.* (2007) find that the probability of licensing is more frequent when patents offer a greater protection (the breadth of a patent approximated by the number of granted claims and technical classes).

Arora and Ceccagnoli (2006) show that the effect of the degree of patent protection on the propensity to license is affected by the existence of downstream capabilities. Using the 1994 Carnegie Mellon survey on industrial research and development in the United States, they find that increases in the effectiveness of patent protection enhance licensing propensity only when few or no complementary assets are necessary to bring the technology to market. Indeed, the control and distribution of downstream co-specialised assets (*e.g.* distribution and manufacturing capabilities or a brand-name reputation) affect directly the share of revenue that can be derived from licensing innovations (Teece, 1986). Firms lacking these competences are the first to opt for commercialisation of technology (licensing-out) as it represents the least costly strategy. Fosfuri (2007) finds a significant negative effect of downstream assets on the probability of licensing chemical compounds for a sample of large petrochemical firms. In a study of 100 start-up firms, Gans *et al.* (2002) find that the probability of getting into co-operation with incumbent firms (through licensing, joint venture…) compared to becoming a product market competitor, is increasing in the relative cost of control of specialised complementary assets and in the innovator's control over IPR (and association with venture capitalists).

As regards company size and licensing, a negative association is frequently advanced. As explained by Arora and Fosfuri (2003), the licensing of technology entails a trade-off: licensing payments net of transaction costs (revenue effect) must be balanced against the lower price-cost margin and/or reduced market share implied by increased competition (rent dissipation effect) from the licensee.[2] The latter is smaller if the licensee is in a distant product or distant geographical market in which the licensor does not operate. Hence, larger companies and companies having a higher market share will suffer the most from allowing entry through licensing. Fosfuri (2006) finds a negative association between the rate of licensing and licensor's market share in the chemical industry. Gambardella *et al.* (2007) report that patents from smaller companies have a higher propensity to be licensed. Motohashi (2008) finds a U-shaped relationship between size and licensing propensity for Japanese companies. In general, smaller firms, especially start-ups in technology-based businesses are more likely to license out since they may lack co-specialised assets needed for accessing product markets. Start-ups have the option to engage in co-operative commercialisation (*e.g.* licensing, acquisitions) by forming alliances with established firms rather than compete in product markets (Gans and Stern, 2003; Kollmer and Dowling, 2004). There are several examples of the importance of specialised technology companies: the "specialised engineering firms" in chemical industries (*e.g.* bulk organic chemicals and petrochemicals); or the alliances between biotechnology firms and big pharmaceutical firms since the early 1980s (Gans *et al.*, 2002).

2. More specifically, the licensing decision depends on the characteristics of the product and technology market in which a licensor firm is operating. Incentives for licensing increase when the product market is sufficiently homogenous and different from the licensors' main products (*e.g.* Arora and Fosfuri, 2003).

3. SURVEY IMPLEMENTATION AND EXPLOITATION

3.1. The design and implementation of the survey

As the samples have been drawn from patent-office files in both surveys (EPO and JPO), the target population is patent holders. Hence the questionnaire focuses on licensing *out* and not on licensing *in*, as patent holders are not a relevant population for conducting a survey on the latter. In the case of the EPO, the questionnaire on licenses and other uses of patents was added to the annual *EPO Applicant Panel Survey* (*c*onducted since 2001). The primary objective of the *EPO Applicant Panel Survey* is to forecast the number of patent filings at the EPO and other patent offices taking into account various filing routes and applicants' residence blocs (EPO member states, Japan, USA, and others). The questions on licensing were addressed only to respondents from EPO member countries: hence all results from the EPO survey reported here apply to European companies only.

The EPO Applicant Panel Survey was carried out via telephone and mail interviews with pre-established contact persons. The main interviews took place from end of May to mid-September 2007. The parent population for the survey comprises applicants who filed patent applications at the EPO in 2006. These applicants are mainly companies, but there are also some organisations and private inventors. The EPO provided three gross samples of applicants drawn from the EPO database of applications in early 2007[3]: the "Biggest" sample, which comprises 425 participants and is designed to represent large applicants separately (more than two filings in 2006); the "Random" sample which includes 1 849 participants and is designed to represent all applicants of the parent population[4]; and the "Smallest" group (no more than two filings in 2006 according to the EPO database records). For EPO member countries, the three samples combined, the response rate was 42.9%, slightly higher than the overall response rate (40.6%). The resulting sample is 612 responding companies (of which 476 are private companies) out of 1 428 companies whose addresses were found.

In Japan, the survey was carried out by the University of Tokyo, in agreement with the JPO. The data collection period was from 20 October till 20 November 2007. It targeted specifically Japanese applicants to the JPO having at least two filings in the 2006 fiscal year. 1 640 valid responses were obtained out of 4 873 valid targets (response rate: 33.7%). The survey is composed of three parts: i) Patenting propensity, appropriability and importance; ii) Licensing activities and iii) Changes in licensing activities and underlying factors.[5] The questionnaire of the EPO survey is given in Annex III. Compared to the EPO questionnaire, some items and questions were omitted in Japan: in the section on motivations for licensing (stop perceived infringement); the questions on the use of patent pools, clearing houses and patent auctions; and the entire section on the uses of patents as financial tools.

3. All gross sample data were taken from the EPO application database (EPASYS) and considered Euro-direct and Euro-PCT regional phase filings only (PCT-IP filings were ignored for the sampling due to a lack of timeliness). All samples were drawn separately.

4. It was obtained from a simple random sample of applications, with the effect of over-weighting large applicants due to their larger numbers of applications.

5. A broader survey on IP related activities by patent holders is conducted by the Japan Patent Office (SIPA Survey). It started in 2002 (for 2001 activities); data are available annually until 2006 (for 2005 data). 5 000-6 000 (applicants) samples out of 16 000 mailing lists. The survey contains information on IPR applications, IPR stocks and its usage, information on IPR section at the firm, and IP related infringement.

3.2. Exploitation of the data

Table 17 in Annex II displays the firm distribution by company size in the EPO and Japanese surveys. The methodology for producing estimates for the Random group and subsets (and imputation of the smallest) was built on the Q-index, used in previous years.[6] This index, modelled as a Poisson distribution based weight term, gives an estimate of the probability of existing in the sample for each participant in the sample. The numerator of this index is a measure of the importance of applicant i in the population (share of filings by applicant i in total filings by all applicants) whereas the denominator is an approximation following a Poisson distribution for the probability of selection of applicant i into the sample.

Data from the EPO survey was rebalanced when integrating the small and random samples through the method of extended structural weights (see EPO Applicant Panel Survey 2007 Report) to reduce the skewness of the sample towards larger applicants. When integrating the different samples (the biggest applicant having a probability of selection in the refereed population of 1), care was taken that the weights of applicants eligible for the Random and the Smallest samples were properly adjusted so as not to inflate the weighted proportion of small applicants in the combined Random and Smallest group. For this purpose it was necessary to calculate the probability that each applicant appears somewhere in the two samples. Multiplicative factors were applied by residence bloc and level of filings.[7] Further, an additional adjustment was made on the combined sample to reflect the population (based on total number of applicants at the EPO and number of filings). As regards the Japanese survey, as it was planned to be exhaustive in the target population, the sample is reported in its original format. The next steps in this investigation will eventually be to adjust data to reflect the population in the same dimensions as in EPO (number of applicants and filings at the JPO).[8]

4. INITIAL ANALYSIS OF THE SURVEY RESPONSES

4.1. Licensing of patents

We report next a first examination of the findings from the two surveys. Care should be taken in interpreting the results and comparing findings from Europe and from Japan as samples and methodologies differ between the two surveys. For EPO, we report only results concerning private companies and individuals (public institutions, government agencies and others were ignored) for the sake of homogeneity (in Japan only companies were surveyed).

Licensing out patents is practiced by a significant share of firms holding patents: 35% of firms in Europe and 59% of Japanese respondents declare having licensed out patents. The difference is positive in

6. *Cf.* Applicant Panel Survey 2001 Report: Annex III; Applicant Panel Survey 2002 Report: Section IV.1, Annex IV.

7. The structural weights obtained were then multiplied by the probability of existence in the population of applicants by resident bloc and level of filings (one over n total applicants in that category of size at EPO) and the inverse of the sample response rate by size class and resident bloc.

8. Correction for non-response rate (*e.g.* applying a similar composition of groups by level of filings as made for the EPO survey) might introduce bias more than accuracy; as there was no pre-defined sample structure and we would force data to reflect an ex-post given structure.

favour of Japan for all size categories, except for the smaller companies (less than 10 employees), for which the number of Japanese respondents is very small, hence not significant. It seems that the share of licensing-out companies is higher among the smallest and notably, among the larger companies, above 1 000 employees. The distribution looks like a U-shape with lower levels of licensing activity in the middle-sized companies (50 to 999 employees). However, this figure mixes two different types of licensing-out: within group licensing (among companies pertaining to the same group) and licensing between independent entities. Much of the licensing activity is between firms belonging to a same group: it is a way of transferring the technology from the most inventive branches of a group (*e.g.* the research labs if they are incorporated as such) to the ones more involved in manufacturing. Intra-group licensing is also a manifestation of international technology transfers within multinational companies which, for accounting and fiscal reasons, must be reported as licensing contracts. However, when one is interested in studying markets for technology, licensing between independent companies is the category of interest. We study these transactions in the following table.

Table 1. Licensing of patents: companies declaring licensing of patents

(% in total responding companies)

	European companies	**Japanese companies**
1-9 emp	43	38
10-49 emp	25	58
50-249 emp	27	43
250-999 emp	28	56
1000-9999 emp	56	77
10000-or more	48	87
Size not available (680 JP firms)	33	42
Total*	**35** (0.03)	**59** (0.02)
No of companies licensing	167	965
No of companies(with employee information)	451	955
# companies	476	1 635

* Average of total responding companies, including companies missing information on employees.
Standard errors in parentheses.

By crossing responses throughout the survey, we have identified companies *engaged into licensing out of patents to non-affiliated parties*.[9] Table 2 reports the share of companies declaring licensing out to independent entities (non-affiliated) in total patenting companies for Europe and Japan. 27% of Japanese companies declared to license patents to non-affiliated partners while the corresponding figure for European is 20%. Hence this activity seems more widespread in Japan.

9. The identification of licensing companies from the questionnaire's responses needed some elaboration of the raw data. Originally, the first question on licensing activity referred to all types of licensing-out of patents: what is the share of holding patents being licensed out? with answers being: 0-20%, 20-40%,…80-100%. Based on responses throughout the survey, we have identified companies doing licensing out of patents (to non-affiliated parties) from those that are not engaged into this type of activity. We have proceeded in two stages. First, a company does this activity if at least one of the questions on the section "licensing activity of your company" is answered (question items: shares of licensing-out, types of licensing-out; changes in deals and revenues over time, motivations and share of patents in total intellectual property rights). Then, we distinguished licensing to non-affiliated companies. For this, we consider that a company licenses out to non-affiliated parties if the question to non-affiliated companies is not 0-20% and some other level is answered. We have looked at the responses on the second question regarding the shares in total patents under license of the following types: i) non-affiliated companies; ii) cross-border licensing (partners abroad), and iii) cross-licensing.; and re-defined the variables on licensing activity to non-affiliated companies.

In the case of licensing out to non-affiliated companies, a U-shaped relationship between size and share of involved companies appears. This result is consistent with the findings by Motohashi (2008) and Fosfuri (2006). A higher share of licensing out among small firms has been already found in other surveys (Patval in Europe; see Gambardella *et al.*, 2008). This result is confirmed by the more controlled exercise reported in Annex I of this document: when controlling for the technical field and the country of the company, we still obtain a U-shaped impact of size on the likelihood of a company to license out to non-affiliated partners. It is probably related to the fact that there are small companies with no manufacturing or commercial facilities, which are then not in a position to exploit their inventions themselves. Hence it makes sense for such small companies to license out their inventions instead of practicing them themselves. Their applications fall outside the range of competences of the firm, and this is more likely to happen if the firm is small and little diversified. In that case the inventing firm might choose to give access to the invention to third parties in a better position to exploit it at least on markets from which the firm is absent.

On the other hand, for the largest companies (10 000 employees and more), there is first a statistical explanation: due to their size, they are involved in a greater variety of activities than other firms, and licensing out is one of these activities. There are economic explanations as well, some of which will be tested below. Larger firms often play the role of technology integrator, their products are made of many different inventions (it is often reported that a mobile phone includes thousands of patented inventions). In order to secure access to all these inventions, which it cannot all produce itself, the large company has to enter into licensing in deals with other inventors, some of these deals involving cross-licensing as competitors want access to the firm's technology. A larger share of large firms involved in cross-licensing would be consistent with this explanation.[10] Another explanation for the higher share of large firms licensing out their patents involves market strategy. Large firms are reported to have set up "patent thickets" in certain fields like semi-conductors (Shapiro, 2001a; Kim and Vonortas, 2006). That gives them more market power that they can better leverage by granting licenses to others: by doing that they mitigate anti-trust concerns, they deter competitive R&D (why spend on R&D when you can license in existing technology?) and they increase revenue. In addition, licensing out can be more or less constrained, as the licensor pressures an alleged patent infringer to license in the invention, under a threat of going to court. Such pressure is obviously easier to exercise for large firms, endowed with a larger legal department, than for small ones. We will test some of these explanations below.

Table 2. Licensing of patents to non-affiliated companies

(% companies declaring licensing of patents in total responding companies)

	European companies	Japanese companies
1-9 employees	33	25
10-49 employees	12	39
50-249 employees	14	20
250-999 employees	16	28
1 000-9 999 employees	29	51
10 000-or more employees	31	74
Size not available	13	19
Total*	20 (0.02)	27 (0.01)
# companies (with employee information)	451	955

* Average of total responding companies, including companies missing information on employees. Standard errors in parentheses.

10. In an examination of the licensing behaviour by US-traded companies, Kim and Vonortas (2006) show that companies behave differently according to the nature of technology: larger firms in industries dealing with more "complex" technologies engage relatively more in cross licensing whereas smaller firms in industries with "simpler" technologies tend to sell technology through exclusive licenses more than others.

The share of their patent portfolio that companies license out to non-affiliated partners is usually quite high: more than half of licensing companies in Europe, and almost three out of four in Japan license 80 to 100% of their portfolio (Table 3). The proportion of the portfolio which is licensed out seems higher among large firms than among SMEs, both in Japan and in Europe, and particularly at the top levels (80-100% of patents being licensed). If we look at the mean proportion of patents within licensing companies, a t-test shows that it is only in the European case that larger companies report significant higher average share than SMEs ($t=-3.04$, $p<0.002$): 4% vs. 2.94%, respectively. The one tailed t-test for Japan is not significant indicating that there is no difference between SMEs and large companies in the intensity of patent licensing ($t=0.35$, $p>0.37$).

Table 3. Intensity of licensing to non-affiliated companies

(% of patents being licensed out)

%	European companies			Japanese companies		
	All	>250 employees	<=250 employees	All*	>250 employees	<=250 employees
0%	80	78	80	73	61	77
>0%	20	22	20	27	39	23
0-20%	7	3	10	1	2	0
20-40%	1	0	1	2	3	1
40-60%	1	3	1	2	3	3
60-80%	1	1	0	2	4	2
80-100%	11	14	9	20	28	17
Total %	100	100	100	100	100	100
Mean proportion of patents being licensed out (licensing companies)	3.34 (0.22)	4.07 (0.22)	2.94 (0.30)	4.48 (0.46)	4.5 (0.06)	4.54 (0.11)
# companies licensing	124	76	48	450	274	58
# companies	476*	234	217	1 635	704	251

* Total of responding companies including companies missing information on employees. Standard errors in parentheses.

The share of cross-border licensing among total licensing seems significant but not overwhelming (Table 4): 64% of European companies doing licensing out license less than 20% of their (licensed) patents to entities located in a different country; 85% of Japanese companies doing licensing out license less than 20% of their patents to foreign affiliated companies. Cross-licensing is also a significant but not an overwhelming type of licensing, with 79% of European companies and 83% of Japanese companies involving less than 20% of their licensed patents in such a type of deals.

Table 4. Types of patent licensing

(Share in total patents subject to licensing)

	Licensing abroad*		Cross-licensing	
	European	Japanese	European	Japanese
0-20%	64	85	79	83
20-40%	8	3	3	4
40-60%	8	3	11	3
60-80%	1	2	0	2
80-100%	19	7	6	8
Total %	100	100	100	100
# companies responding	141		141	

* Figures from Europe and for Japan are not directly comparable for this question. In the EPO survey licensing abroad concerns "partners located abroad" while in the survey for Japan, the question refers to licensing to foreign affiliated companies.

Within Europe, there are cross-country differences in terms of licensing activity (Table 5). Denmark followed by Austria, the United Kingdom and France appear as having the largest shares of companies being involved in some of type of licensing-out of patents. Companies from the Netherlands, Sweden, Italy and Germany are below the average share of licensing activity (20% of companies). However, these cross-country differences are partly due to structural effects (*e.g.* sector or size composition of national industries). Controlling for some of these factors is done by a regression exercise (see Annex I) and this actually confirms these results as the higher shares of companies involved in patent licensing are from the UK and, to a much lesser extent, from Nordic countries.

Table 5. Companies licensing out patents to non-affiliated entities

(Share in total responding companies)

Country	% of companies doing licensing	Total of companies
Denmark	42	16
Netherlands	15	18
Austria	36	22
Sweden	8	25
France	33	29
United Kingdom	34	39
Italy	10	40
Switzerland	25	49
Germany	15	203
Total	20	476

Table 6 reports licensing rates to non-affiliated companies broken down by the year of foundation of companies. Older companies, those created before 1960, report lower shares of licensing activity as compared with firms born after 2000 and those born between 1961 and 2000. The Pearson chi2 and F tests on the association between age groups and being involved in patent licensing are however not significant.[11]

Table 6. Licensing of patents to non-affiliated companies and foundation year (European companies)

(% companies declaring licensing of patents in total companies)

	<=1960	>1960 and <=2000	>2000	All
Companies not engaged	85	78	80	80
Companies doing licensing	15	22	21	20
# companies	172	166	116	454*
Pearson unadjusted χ^2	2.33 (n. s.)			
Pearson design-based F	0.85 (n. s.)			

* Companies reporting information on year of foundation. n. s. not significant.

11. When discriminating between companies born since 2000 and the rest, the multivariate analysis in Annex I confirms though that younger companies tend to license patents more.

Companies were asked to evaluate the evolution of their licensing activity between 2003 and 2006 (Table 7). Among European companies doing licensing in 2006, 45% declared their licensing revenue has increased, including 8% which reported dramatic growth. This rise seems to be associated to the number of contracts, not to increases in licensing fees[12].

Table 7. Evolution of the licensing activity 2006 compared to 2003 (European companies)

(Share of companies in total companies doing licensing by type of evolution)

	Licensing companies	
	Change in licensing revenue	Change in the number of deals
Increased dramatically	8	8
Increased	37	39
Not changed	53	51
Decreased	3	3
# companies	113	113

Table 8 reports the share in IPR licensing contracts involving trademarks, copyrights, and know-how. Interestingly, companies that license patents (to non-affiliated companies) seem to more frequently integrate transfers of know-how (41% of companies declared to integrate it in more than 20% of their contracts of IPR), while less than 4% declared to include trademarks. Companies who are not engaged in licensing of patents to third parties do contract much less on other forms of intellectual property, and few of them include know-how in their contracting activity. The Pearson tests and survey-based Fisher test are significant for the three items, which indicates that there is an association between being a patent licensing company and the level of contracting on trademarks, copyrights and know-how. A one tailed t-test on the difference of mean share (Ha: licensing companies having larger mean shares) confirms that the share in IPR licensing contracts involving trademarks, copyrights and know-how is statistically larger in the group of companies that license patents to other parties: $t=-3.13$ ($p<0.001$), $t=-2.25$ ($p<0.02$) and $t=-6.02$ ($p<0.0001$), respectively.

Table 8. Share in IPR licensing contracts involving trademarks, copyrights, and know-how (European companies)

	Companies doing patent licensing			Companies not involved in patent licensing		
	Trademarks	Copyrights	Know-how	Trademarks	Copyrights	Know-how
0-20%	80	88	59	96	97	95
>20%	20	12	41	4	3	5
20-40%	7	5	7	2	2	2
40-100%	13	7	34	2	1	3
Mean %	1.32	1.19	1.75	1.05	1.03	1.08
	(0.08)	(0.06)	(0.11)	(0.02)	(0.01)	(0.02)
Compared licensing to non licensing companies:						
Pearson unadjusted χ^2	32.88***	16.43**	98.96***			
Pearson design-based F	11.78***	5.77**	38.70***			
# companies	125			352		

* Significant at 10% level, ** 5 % and *** 1%. Standard errors in parentheses.

12. These figures are somewhat biased by the fact that companies which did not license out in 2006 but had done so in 2003 might not have responded to the question (because they disappeared during this period of time, or because they were not included in the survey sample as they had not filed for patents since then, or for any other reason).

Table 9. Share in IPR licensing contracts involving trademarks, copyrights, and know-how (Japanese companies)

	Companies doing patent licensing			Companies not involved into patent licensing		
	Trademarks	Copyrights	Know-how	Trademarks	Copyrights	Know-how
0-20%	89	95	76	92	98	93
>20	11	5	4	8	2	7
20-40%	4	1	10	3	1	3
40-100%	7	4	14	5	1	4
Mean %	1.18	1.08	1.37	1.13	1.04	1.12
	(0.02)	(0.02)	(0.03)	(0.01)	(0.01)	(0.01)
Compared to companies not involved in patent licensing:						
Pearson χ^2	6.17	7.57**	80.73***			
# companies	450			1203		

** Significant at 5% level, *** significant at 1%. Standard errors in parentheses.

Japanese companies who are patent licensors seem to include more intensively copyrights and know-how than companies not engaged in licensing of patents but the distribution of trademark contracting is not significantly different between licensing and non-licensing companies as reported by the chi2 test. The t-tests on the difference of mean shares between the two types of companies also confirm that licensing companies do involve more frequently copyrights and know-how in IPR contracting: t=-2.34 ($p<0.01$), t=-7.16 ($p<0.001$), respectively. There is no statistically significant difference between the mean share of trademark contracting in the total of IPR licensing contracts for licensing and non-licensing companies (t=-1.65 ($p>0.70$).

4.2. Motivations for licensing (out) patents

What are the actual motivations of companies for licensing out their patents (see Table 9)? The first motivation, by far, to license patents to third parties is "*earning revenue"* for both European and Japanese companies. That confirms findings from previous surveys (Patval; see Gambardella 2005). The financial motive is far stronger for smaller than for larger firms in Europe, while there is no significant difference between smaller and larger companies in Japan. The second motivation for both European and Japanese companies is *"entering into cross licensing deals"*. It is far more important for large companies than for smaller ones in the two regions (more so in Europe), confirming one of the explanations given above for the high share of larger firms which license out their patents.

In Europe, the motivation "*stop others from infringing your patents"* (the question was not asked in the Japan survey) comes in third place. This can be seen to a certain extent as forcing a license through: the patent holder has identified an alleged infringer and proposes him/her a license so as to avoid going to court. It is noticeable that this motive is exactly the same in importance for large and smaller firms. This motive is followed in Europe by setting the inventor's technology as standard (licensing boosts the diffusion of the invention, which might therefore become a *de facto* standard); this is of interest to the inventor as it will in turn increase the demand for the invention by users for whom it would not have been the first choice but who use this particular invention to be compatible with others. "Outsourcing manufacturing" (*i.e.* a firm licenses out in order not to manufacture the product, *e.g.* because it does not have the manufacturing facilities or competences) is a very weak motivation in Europe. It comes in third place in Japan, jointly with "establishing your technology as a standard". Finally, sharing technology with other companies, a notion close to open innovation (which was explicitly mentioned in the European, but not the Japanese questionnaire) is a significant but not primary motive in Europe, and a marginal one in Japan (this might be due to the way the question was formulated).

Table 10. Motivations for licensing out: share of deals concluded in the previous three years obeying the following motivations

(Average shares reported)

	European Companies			Japanese Companies		
	All	>250 employees	<=250 employees	All	>250 employees	<= 250 employees
Earning revenue	60 (5.5)	40	70	52 (2.00)	54	55
Entering into cross-licensing	18 (4.18)	28	12	18 (1.66)	19	16
Sharing technology with other companies (open innovation)	10 (2.87)	8	11	5 (0.81)	3	6
Establishing your technology as a *de facto* standard	12 (3.31)	12	11	11 (1.15)	8	14
Outsourcing manufacturing	4 (1.97)	3	4	11 (1.15)	10	14
Stopping perceived infringement of your patents	14 (3.82)	14	14			
# companies (active in licensing)	124	48	76	460	274	58

Note: Tabulations conditional on companies being engaged into licensing to non-affiliated companies. When responses were missing and other responses already added up 100% (or above), these were assumed to be zero (not motivated by such a reason to license out). Standard errors in parentheses.

4.3. Obstacles to licensing

Although they are expanding, licensing markets are still underdeveloped, compared to their potential. An important number of patented inventions could be commercialised and exploited by third parties but their owners have not succeeded in licensing them out. The reasons for this have to do with the difficulty in finding partners and concluding licensing deals: existence of transaction costs, how to go about seeking potential partners, lack of experience in drafting contracts, disagreements on exploitation conditions such as geographical or exclusivity restrictions or payment conditions (royalties, lump sum, etc.). Many of these difficulties are due to the particular nature of knowledge as an economic good. Notably, pieces of knowledge being all different from each other, there is little standardisation, making it difficult to have references such as common price or standard contracts. The potential user of a given piece of knowledge can remain unknown to the seller, who thus cannot contact him/her. This increases the difficulty in negotiating deals, generating potential market failures (OECD 2006a).

This line of reasoning is supported by some recently collected evidence.

- According to the PATVAL-European Union Survey: less than 10% of patents are subject to licensing outside the company, whereas 10-15% of inventions are candidates for license.[13] According to the estimated economic value of these inventions (as declared by inventors), this would imply a significant potential for increasing the total value of licensing activity (50% potential increase in the size of the market). The inventions that have not been licensed but are candidates for license are not significantly different from other inventions in terms of quality.

- A survey conducted by the Japanese Patent Office (JPO) on similar issues reports lower figures on licensing activity and willingness to license. Accordingly, 8% of JPO patents are licensed, while 7% are unsuccessfully offered to license.

13. According to the PATVAL-European Union Survey on the value of patents, the share of patents that are not used at all is significant: 35% of patents are not used at all; 18.7% of inventions are actually patented with the aim of blocking.

In the OECD survey, 24% of European patenting firms declare that they have patents that they were willing to, but could not, license out whereas more than 50% of Japanese patenting firms would like to license (Table 11 and Table 12). For European firms not engaged in licensing to unaffiliated parties, 19% of them declare to be willing to license some of their patents but have not succeeded. This proportion is much higher for firms who are already active in licensing: 45% of these companies want to license more. The Pearson and Fisher (design-based) tests confirm that the distribution of this variable differs between the two groups of companies, which indicates that there is an association between being a licensing company and the level of patents that companies would be willing to license out (Pearson unadjusted χ^2=28.45 with p-value=0.001, adjusted F=7.65 with p-value=0.001). The decomposition into large and SMEs shows that this situation only occurs within SMEs.[14] The pattern is the same among Japanese companies (Table 12): around 80% of companies that license patents would like to do more; less than half the companies not licensing would like to. As in the European case, the Pearson test confirms that Japanese companies that are already licensors have a different distribution (χ^2 =181.03 with p-value<0.0001). The t-tests on the difference of means confirm that licensing companies report statistically significant higher shares of patents willing to be licensed and this situation holds in both large and SMEs companies.[15] Hence licensing markets could be much bigger than they actually are if all possible transactions were carried out: these figures have to be interpreted carefully however, as they reflect only the point of view of licensing suppliers, not of the potential buyers. Some of the transactions are not carried out simply because there is no demand. These figures have to be seen as higher range estimates of the actual untapped potential market offered by patentees.

For European companies, the share of "frustrated licensors" is higher among firms with more than 250 employees than among firms with 250 and less employees if they are not already engaged in licensing transactions. Among licensing companies, a higher share of frustrated companies is reported by smaller firms: 50% of them would be willing to license more against 36% in the case of larger companies. Moreover, amongst the smaller companies, 48% would be willing to license more than 20% of their patent portfolio. There is no significant difference within licensing companies in terms of willingness to license: around 80% of companies, SMEs or larger, would like to license out a patent.

14. In the European sample, a one-tailed t-test on the difference of mean share (Ha: licensing companies having larger mean shares) confirms that licensing companies have significantly larger mean shares of patents that they would be willing to license out: t=-2.63 (p<0.005). This result holds true in particular within SMEs: t=-2.75 (p<0.005). On the contrary, there is no statistically significant difference of mean shares between licensing and non-licensing companies within the group of large firms: t=-0.54 (p>0.58).

15. In the Japanese sample the one-tailed t-test on the difference of mean share of patents willing to be licensed but could not actually license between licensing and non-licensing companies is significant: t=13.34 (p=0.0001); and these results hold true within large firms and SMEs (t=8.85 with p<0.0001, t=-5.61 with p<0.0001, respectively).

Table 11. Share (%) of your patent portfolio that you would be willing to license out but could not actually license (European companies)

		Non-licensing firms			Licensing firms		
Share of patents	Sample	All	<=250 emp	>250 emp	All	<=250 emp	>250 emp
0%	76	81	83	76	55	50	64
>0%	**24**	**19**	**17**	**24**	**45**	**50**	**36**
1-20%	5	5	2	10	9	3	21
20-40%	8	7	5	9	16	20	8
40-100%	10	8	10	5	20	27	7
%	100	100	100	100	100	100	100
Mean %	9.78	7.98	8.80	6.24	16.91	21.75	8.19
	(1.29)	(1.39)	(1.87)	(1.83)	(3.08)	(4.33)	(3.07)
# companies	476	352	183	169	124	48	76
Licensing *vs.* no licensing companies:							
Pearson unadjusted χ^2		28.45***	23.85***	5.76			
Pearson survey-based F		7.65***	8.41***	1.47			

*** Significant at 1% level.

Table 12. Share (%) of your patent portfolio that you would be willing to license out but could not actually license (Japanese companies)

		Non-licensing firms			Licensing firms		
Share of patents	Sample	All	<=250 emp	>250 emp	All	<=250 emp	>250 emp
0%	47	58	59	50	22	21	20
>0%	**53**	**42**	**41**	**50**	**78**	**79**	**80**
0-2%	14	14	11	19	15	7	18
2-6%	8	7	6	9	12	19	15
6-15%	10	7	10	8	17	22	16
15-100%	20	15	14	14	34	31	31
%	100	100	100	100	100	100	100
Mean %	2.42	2.08	2.08	2.18	3.25	3.36	3.20
	(0.04)	(0.05)	(0.11)	(0.07)	(0.08)	(0.19)	(0.09)
# companies	1 537	1 091	175	400	446	58	265
Licensing *vs.* no licensing companies:							
Pearson χ^2		181.03***	72.80**	33.85***			

Note: ** Significant at 5 % and *** significant at 1% level.

Table 18 in Annex II reports the willingness to license technologies by technology field.[16] The highest share of respondents declaring unrealised deals are found in telecommunications followed by audio, video and media.

What are the actual obstacles faced by firms willing to license out? Table 13 displays the importance of factors that companies have been confronted with when attempting to license their technologies. In the two areas, the main hampering factor by far is the difficulties to find partners: 25% of European companies and 18% of Japanese companies considered it as a very important factor. Other factors have lower importance, both in Europe and in Japan: the complexity and cost of drafting and negotiating contracts, the lack of readiness of the invention, the too low level of the price offered. For European companies, all factors are deemed more important by smaller companies (less than 250 employees) than by larger ones. In particular, 30% of smaller European companies declared the difficulty of identifying a partner as being a

16. The figures computed correspond to responses given to the section C of the questionnaire regarding filings by technology cluster (EPO classification); hence the rate of licensing to non-affiliated parties is based only on the total of companies answering this section.

very important impediment to licensing. According to the Pearson adjusted test, it appears that the difference in perception between size groups regarding this hampering factor is the only one that is statistically significant. No significant difference exists between companies born before or after 2000 in the appreciation of obstacles.

Whether or not a company is already a licensor seems to have an incidence. Obviously, licensing companies know more about the real difficulties in patent markets given their experience: they consider the obstacle of identifying partners and negotiating prices statistically more important than do companies who do not license out patents. In the case of Japanese companies, larger firms and firms who are licensors consider identifying partners statistically more difficult than do their counterparts, SMEs and companies that do not license, respectively. The remaining obstacles are valued pretty much equally by companies regardless of their size or whether they are in the patent licensing business or not. The lower level of difficulty in identifying a partner reported by Japanese SMEs as compared with larger firms (13% *vs.* 23%) might be explained by the existence of the INPIT (National Center for Industrial Property Information and Training, established in 2001), an emanation of the Japanese government which plays a crucial role as information provider and facilitator in transactions involving patents. The INPIT targets, notably, Japanese SMEs, which appear less hampered by all factors relative to large firms than European SMEs do.

Table 13. Obstacles to licensing patents

Hampering factors you have been confronted with in your licensing activity

(% of companies declaring as being a "very important factor")

	Identifying partner is difficult	Price offered is too low	Drafting and negotiating contracts is too complex/costly	Technology is not developed enough (lacking prototype etc.)
European companies				
All	25	13	17	16
>250 emp	16	8	11	10
<=250 emp	30	15	20	19
Pearson design-based F	4.85**	1.68	2.16	2.21
Year of foundation				
<2000	26	13	16	15
>=2000	21	5	18	16
Pearson design-based F	0.57	1.16	0.10	0.06
Not licensing	21	9	19	14
Licensing companies	34	19	12	19
Pearson design-based F	3.17*	3.31**	1.45	0.60
# companies	227	212	213	219
Japanese companies				
All	18	3	4	5
>250 emp	23	2	4	5
<=250 emp	13	3	3	2
Pearson χ^2	8.65***	2.68	0.16	2.49
Not licensing	16	3	4	6
Licensing companies	21	3	4	4
Pearson χ^2	4.69**	0.04	0.26	0.81
# companies	1 521	1 504	1 505	1 502

* Significant at 10% level, ** 5 % and *** 1%.

4.4. Financial uses of patents

A section on the financial uses of patents was included in the EPO survey. These questions address the importance of patents for raising funds through various channels and sources: venture capital, private investors, stock market, and securitisation, negotiating loans (collateral) or obtaining public aids. The innovation literature points to two main potential roles of patents in this area, both aimed at addressing

informational imperfections of financial markets. First, patents are a signalling device; they inform the funder about the quality of the invention that the funds are aimed at developing. It is reported that venture capitalists in certain fields like biotech will often not consider a submission which does not include a patent. Second, patents can be a financial guarantee: in case the funded firm goes bankrupt, the funder might take control of some of its assets, including patents. It is expected that patents as financial instruments are more important for younger enterprises, notably those in high technology areas, because they often have little other assets to show and often little or no cash flow. As regards company size, we would expect that patents might be more useful for smaller firms since larger companies profit from diverse sources of capital, enjoy reputation effects, have easier access to financial markets and in any case have more cash flow.

Figures are reported in Table 14. Convincing venture capitalists and private investors are the two most important financial uses of patents, ranked as such by 11% and 13% of European respondents. Securitisation is still marginal (3%) as could be expected (there is little securitisation activity involving intellectual property observed in financial markets). Other uses are in-between. In line with our expectations, the various financial uses are more important for smaller companies (with less than 250 employees) than for larger ones. In particular, patents turn out to be more useful for raising venture capital and accessing private investors (13% and 16% of smaller companies in this category considered patents as "very important" factors compared to 7% and 6% in large companies). Actually, the Pearson adjusted test confirms that these two sources of finance are significantly more important for SMEs. More interestingly, the size factor seems to be less relevant than the age factor: younger companies, founded after 2000, give far higher importance to patents for raising funds than older ones, in particular to access venture capital and private investors (the Pearson adjusted F tests are 21.56 and 34.18 respectively both with $p<0.001$). The Pearson tests on these two items are higher in the case of age groups than in size groups. 40% and 31% of companies founded after 2000 declared patents to be very important for raising private equity and venture capital respectively. Patents are also valued significantly as very important for negotiating loans and obtaining public subsidies by younger companies. 14% of companies born since 2000 consider patents as very useful for negotiating loans. Regarding the access to public subsidies, 13% of the younger firms see patents as important means, against 6% of older ones (born before 2000).

Table 14. Financial uses of patents by European companies

How important are patents for the following operations?

(% of companies declaring "very important" the factor for raising capital in total responding companies)

European companies	Venture capital	Private investors	Stock market	Securitisation	Negotiating loans (collateral etc.)	Obtaining public subsidies
All	11	13	6	3	5	8
<=250 employees	13	16	6	3	6	10
>250 employees	7	6	6	4	4	4
Pearson design-based F	3.20***	2.91***	0.79	0.49	1.32	1.74*
Foundation year						
<2000	8	8	6	3	4	6
>=2000	31	40	8	4	14	13
Pearson design-based F	21.56***	34.18***	0.33	0.03	7.86**	2.90**
# companies	285	290	281	281	284	285

* Significant at 10% level, ** 5 % and *** 1%.

4.5. Collective mechanisms for organising transactions involving patents

The European survey addressed collective mechanisms which can structure transactions involving patents: patent pools, clearing houses, patent auctions. Patent pools are agreements between patent holders to put their patents together in a pool which will be licensed out as a package (including to the patent holders). Such pools are notably found in industries where standards are important, as standards are often based on various inventions, all necessary for the technology to work (*e.g.* MPEG-2). Clearing houses are arrangements where patent holders agree collectively to cross-license their patents. Patent auctions are events where patents are put for sale to the highest bid. They have developed since 2006, pioneered notably by a company named Ocean Tomo. The survey confirms that these mechanisms still concern a small number of firms in Europe. It is less so for patent pools, which are an older type of arrangement. The use of these mechanisms is not differentiated by the size of companies.

Table 15. Collective mechanisms

Do you use the following mechanisms?

(% of companies in total responding companies)

	Patent pools	Clearing houses	Patent auctions
<=250 employees	6	3	3
>250 employees	6	2	2
Total	6	3	3
# companies	311	302	301

5. LESSONS AND POLICY IMPLICATIONS

The survey on patent licensing has provided new statistical evidence, notably on the following issues:

- About 20% of European companies and 27% of Japanese companies holding patents license out at least one of their patents to an unaffiliated partner.

- The relationship between size and probability to license out among patent holding companies is U-shaped: the smallest ones and the largest ones are more often involved in licensing out than medium-sized ones.

- The highest proportion of firms license-out in Europe is found in the UK, followed by Nordic countries.

- Earning revenue is the major motivation for licensing out, followed by sharing technology with other companies. “Constrained licensing” (pressuring alleged infringers to take a license) is also important in Europe.

- Cross-licensing out is the second motive for licensing out, both in Europe and in Japan: that shows a role played by patents in technology exchanges between companies.

- About 24% of firms in Europe declare having patents that they would be willing to license out but could not (53% of firms in Japan). The figures are higher within licensing companies and still higher among small firms. The major reason for this failure, according to the European and Japanese surveys, is the difficulty in identifying a partner.

- The use of patents for raising funds is recognised as very important by many European firms, notably for venture capital (11%) and private equity (13%). This rating is much higher for young firms (31% and 40% respectively).

The survey shows that licensing markets are less developed than they could be, in view of the willingness of patent holding companies to license more of their portfolio. Helping suppliers to find partners would substantially increase transactions in patent markets. Both market and government solutions exist which could alleviate obstacles and reduce transaction costs. Market-based mechanisms have recently emerged (technology brokers, internet platforms, patent funds, auction houses, IP consulting companies, etc.). They propose a variety of services to intellectual property holders to facilitate the commercialisation of their assets, including: patent (portfolio) value assessment, logistic and financial services, searching for partners and assistance in establishing partnerships; monetisation of patents (proper accounting practices), etc. (OECD 2006a; 2006b). Little is known about these developments however except for anecdotal evidence. This survey tends to show that they are little utilised in Europe and in Japan: most of them are based in the US, where their impact is probably more significant. Public policy has been implemented in Japan with the aim to facilitate technology transactions, with the creation of the INPIT (National Center for Industrial Property Information and Training), a body close to the Japan Patent Office which operates as an information repository, helping notably SMEs to find partners. The weaker difficulties reported in this survey by Japanese SMEs as compared with European ones for finding licensing partners might be an encouraging signal in this regard.

This study has gone some way in assessing the importance of licensing in companies' patent portfolios and the degree of unsuccessful licensing by patent owners. A proper evaluation of the private and public mechanisms that could help solve market failures in patent markets has yet to be made before specific policy implications can be drawn from this study.

ANNEXES

Annex I: Multivariate analysis on the determinants of licensing

In this section we conduct a multivariate analysis on the determinants of licensing to non-affiliated companies. It allows us to test simultaneously, hence more robustly, the relevance of some factors in the licensing activity of firms, notably size, technology field and country of origin. We estimate a probit model explaining the probability of a firm being engaged in licensing activity to non-affiliated parties.

Economic information on companies reported in the survey is very limited as the main purpose was the identification of trends and frequency of licensing and other economic uses of patents (*e.g.* financial uses). In addition to the number of employees, we include the number of patents (total number of filings to EPO, directly and through PCT), the year of foundation of the firms and the percentage of total inventions which were patented (in 2006). Although we do not know the industrial sector the company belongs to, we can identify the main technology area of company (using the section F of the questionnaire on filings by technology cluster, EPO classification)[17].

The results reported in Table 16 confirm the findings of simple cross-tabulations reported above. The U-shaped relationship between size and probability of licensing out is confirmed even when controlling for the main technology area of the company and the country of residence (column 2). This result is consistent with the one reported by Motohashi (2008) on Japanese companies. Once introduced the year of foundation, the relationship between size and probability to license out is less significant but it still holds (column 3).

17. For companies reporting patenting in several fields (26 companies), only the first field has been retained and we have controlled for this effect by including a dummy on multiple field patenting.

Table 16. Probability of licensing to non-affiliated companies by European Companies (marginal effects)

	1	2	3
Employees	0.031	-0.214	-0.151
	(0.013)**	(0.077)***	(0.087)*
Square employees		0.024	0.02
		(0.008)***	(0.008)**
Foundation year			0.001
			(0.001)**
Multiple technologies (dummy)	-0.086	-0.098	-0.087
	(0.09)	(0.09)	(0.10)
Germany	-0.027	-0.026	-0.007
	(0.06)	(0.06)	(0.07)
United Kingdom	0.227	0.194	0.23
	(0.115)**	(0.115)*	(0.128)*
France	-0.096	-0.118	-0.081
	(0.10)	(0.09)	(0.11)
Nordic	0.115	0.099	0.147
	(0.10)	(0.10)	(0.11)
Biotechnology	0.096	0.117	0.134
	(0.13)	(0.13)	(0.13)
Electricity and Semiconductors	-0.027	0.004	-0.036
	(0.10)	(0.11)	(0.10)
Electronics	0.249	0.266	0.324
	(0.17)	(0.17)	(0.178)*
Polymers	0.179	0.173	0.381
	(0.19)	(0.20)	(0.23)
Pure and Applied Organic	0.366	0.369	0.43
Chemistry (inc. pharma.)	(0.111)***	(0.111)***	(0.123)***
Telecommunications	0.253	0.202	0.27
	(0.18)	(0.19)	(0.25)
Observations	327	327	288
Log likelihood	-175.37	-170.28	-143.99
LR χ^2	32.11	42.30	50.40
Pseudo R^2	0.08	0.11	0.15

Note: The sample including technology effects considers only companies who have declared patenting filings by technology field (15 cluster classifications according to the EPO). For companies having multiple patenting (26) only the first field has been retained and we have controlled for such an effect by including a dummy on multiple field patenting. Only technology fields found significant are reported (reference being other technology fields). The reference in country dummies is "Other countries": Austria, Belgium, Switzerland, Spain, Iceland, Italy, Netherlands, Poland and Portugal.
* significant at 10%; ** significant at 5%; *** significant at 1%.
Standard errors in parentheses.

Annex II: Additional Tables

Table 17. The firm distribution of the EPO and Japanese surveys

	European companies (weighted)		Japanese companies	
1-9 employees	70	14.71	8	0.49
10-49 employees	66	13.87	36	2.19
50 -249 employees	95	19.96	207	12.58
250-999 employees	80	16.81	409	24.86
1000-9 999 employees	100	21.01	264	16.05
10000 or more employees	65	13.66	31	1.88
Missing employee information			690	41.95
Total of companies	476	100%	1645	100%

Table 18. Licensing to non-affiliated companies by technology field in the European sample

	Nb. of companies	% of their patents willing to license	# companies licensing	% willing to license in licensing firms	% willing to license in non licensing firms
Biotechnology	14	0.34	6	0.57	0.17
Civil Engineering; Thermodynamics (including engines and pumps)	57	0.26	21	0.42	0.17
Computers	10	0.26	5	0.48	0.00
Electricity and Semiconductor Technology	21	0.27	7	0.18	0.30
Electronics	12	0.29	6	0.45	0.12
Handling and Processing	30	0.18	13	0.51	0.02
Human Necessities (including agriculture, medical products, printing)	72	0.27	35	0.40	0.19
Industrial Chemistry	18	0.43	12	0.41	0.47
Polymers	13	0.34	7	0.19	0.48
Pure and Applied Organic Chemistry (including pharmaceuticals)	22	0.36	16	0.53	0.00
Telecommunications	10	0.55	9	0.55	0.00
Vehicles and General Technology (including transporting mechanisms, lighting)	42	0.18	24	0.43	0.00
Total (on the sample of companies declaring patenting by technology)	337	0.27	168	0.43	0.15

Note: The tabulation is made on data from companies who have reported information by technology field and only technology fields having at least 10 patenting companies are reported. See the 2007 EPO Applicant Panel Survey: http://www.epo.org/patents/surveys/future-patent-filings.html.

Annex III: The Survey Questionnaire

The first part of the questionnaire will include the identification of the responding firm: size, industry, age (start-ups *vs.* older firms), the multinational or purely national nature of the firm.

1. Licensing out activity of your company

1.1. What is the share, in your patent portfolio, of patents which are currently:

	0-20%	20-40%	40-60%	60-80%	80-100%
licensed out					

1.2. What is the share, among patents licensed out, of those which are:

	0-20%	20-40%	40-60%	60-80%	80-100%
licensed out to companies not affiliated with the same group as yours					
licensed out to partners located abroad					
cross-licensed					

1.3. Evolution of your patent licensing activity with non-affiliated partners

In 2006 as compared with 2003	Your total licensing revenue has	The total number of deals has
Increased dramatically	☐	☐
Increased	☐	☐
Not changed	☐	☐
Decreased	☐	☐

1.4. What is the share in total IP licensing contracts of those involving the following types of IP (as one contract can involve several types of IP, the total of your response could exceed 100%)?

	0-20%	20-40%	40-60%	60-80%	80-100%
Patents					
Trademarks					
Know-how					
Copyright					

2. Motivations for licensing out patents: What is the share of deals concluded in 2003-2006 obeying the following motivations (as one deal can have several motivations the total of your response could exceed 100%):

	Share in total deals (%)
Earning revenue	
Entering into cross-licensing deals	
Sharing technology with other companies (“open innovation”)	
Establishing your technology as a *de facto* standard	
Outsourcing manufacturing	
Stop perceived infringement of some of your patents	

3. Do you use the following mechanisms?

	Yes	No
Patent pools		
Patent clearing houses		
Patent auctions		

4. Obstacles to licensing (out) patents:

4.1. Share (%) of your patent portfolio that you would be willing to license but could not actually license:

	0%	0-2%	2-6%	6-15%	15-100%
Share in total patents					

4.2. What hampering factors have you been confronted with in your licensing activity?

	Not relevant	Weakly important	Moderately important	Very important
Identifying partner is difficult	☐	☐	☐	☐
Price offered too low	☐	☐	☐	☐
Drafting and negotiating contracts is too complex/costly	☐	☐	☐	☐
Technology not developed enough (lacking prototype etc.)	☐	☐	☐	☐

5. Financial uses of patents. How important are patents for you in the following operations:

	Not relevant	Weakly important	Moderately important	Very important
Raising capital, through				
- Venture capital	☐	☐	☐	☐
- Private investors	☐	☐	☐	☐
- Stock market	☐	☐	☐	☐
- Securitisation	☐	☐	☐	☐
Negotiating loans (collateral etc.)	☐	☐	☐	☐
Obtaining public subsidies	☐	☐	☐	☐

REFERENCES

Anand, B. N. and T. Khanna (2000), "Intellectual Property Rights and Contract Structure", *Journal of Industrial Economics*, XLVIII, 103-135.

Arora, A. (1995), "Licensing Tacit Knowledge: Intellectual Property Rights and the Market for Know-how", *Economics of Innovation and New Technology* 4 (1995), pp. 41-59.

Arora, A. and A. Fosfuri (2003), "Licensing the Market for Technology", *Journal of Economic Behavior & Organization*, 52-2, October, pp. 277-295.

Arora, A., A. Fosfuri and A. Gambardella (2001), "Markets for Technology: the Economics of Innovation and Corporate Strategy", MIT Press, Cambridge, MA (2001).

Arora, A. and A. Gambardella (1994), "The Changing Technology of Technical Change: General and Abstract Knowledge and the Division of Innovative Labour", *Research Policy* 23 (1994), pp. 523-532.

Arora, A. and M. Ceccagnoli (2006), "Patent Protection, Complementary Assets, and Firms' Incentives for Technology Licensing", *Management Science* 52 (2006), pp. 293-308.

Arora, A. and R. Merges (2004), "Specialized Supply Firms, Property Rights and Firm Boundaries", *Industrial and Corporate Change* 13 (2004), pp. 451-475.

Arrow, K. (1962), "Economic Welfare and the Allocation of Resources for Invention.In: the Rate and Direction of Inventive Activity: Economic and Social Factors", NBER Conference no. 13, Princeton: Princeton University Press.

EPO: EPO Applicant Panel Survey, on: http://www.epo.org/patents/surveys/future-patent-filings.html.

Fosfuri, A. (2006), "The Licensing Dilemma: Understanding the Determinants of the Rate of Technology Licensing", Working Paper, April 2006, University Carlos III of Madrid.

Gallini, N.T. (1984), "Deterrence by Market Sharing: a Strategic Incentive for Licensing, *American Economic Review,* 74 (1984), pp. 931-941.

Gambardella, A. (2002), "'Successes' and 'Failures' in the Markets for Technology", *Oxford Review of Economic Policy*, 18 (1), 2002.

Gambardella, A., P. Giuri and A. Luzzi (2007), "The Market for Patents in Europe", *Research Policy*, 36 (8), October 2007, pp. 1163-1183.

Gambardella, A. and M. Giarratana (2007), "Innovations for Products, Innovations for Licensing: Patents and Downstream Assets in the Software Security Industry", Mimeo. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=935210

Gans, J. S. and S. Stern (2003), "The Product Market and the Market Forideas: Commercialisation Strategies for Technology Entrepreneurs", *Research Policy*, 2003, 32, pp. 333-350.

Gans, J., D. Hsu and S. Stern (2002), "When Does Start-Up Innovation Spur the Gale of Creative Destruction", *RAND Journal of Economics*, 33 (2002), pp. 571-586.

Giuri, P. *et al*. (2007), "Inventors and Invention Processes in Europe: Results from the PatVal-EU Survey", *Research Policy*, Volume 36, Issue 8, October 2007, pp. 1107-1127.

Grindley, P. and D. Teece (1997), "Managing Intellectual Capital: Licensing and Cross-Licensing in Semiconductors and Electronics", *California Management Review*, 39, pp. 8-41.

Hall, B. and R. Zeidonis (2001), "The Patent Paradox Revisited: an Empirical Study of Patenting in the U.S. Semi-conductor Industry", 1979-1995, *RAND Journal of Economics,* 32 (1), pp. 101-128.

Kim, Y. J. and N. Vonortas (2006), "Determinants of Technology Licensing", *Managerial and Decision Economics,* 27 (4), pp. 235-49.

Kollmer, H. and M. Dowling (2004), "Licensing as a Commercialisation Strategy for New Technology-Based Firms", *Research Policy*, 33 (2004), pp. 1141-1151.

Merges, R. (1998), "Property Rights, Transactions, and the Value of Intangible Assets", University of California at Berkeley, Working Paper.

Motohashi, K. (2008), "Licensing or Not Licensing? An Empirical Analysis of the Strategic Use of Patents by Japanese Firms", *Research Policy*, forthcoming.

Nagaoka, S. (2005), "Determinants of High-Royalty Contracts and the Impact of Stronger Protection of Intellectual Property Rights in Japan", *J. Japanese Int. Economies*, 19 (2) (2005) 233–254.

OECD (2006a), "Valuation and Exploitation of Intellectual Property", by S. Kamiyama, C. Martinez and J. Sheehan (2006), *STI Working Paper*, OECD.

OECD (2006b), "Summary of the EPO-OECD-UKPO Conference: Patents, Realising and Securing Value", OECD, http://www.oecd.org/dataoecd/23/4/37952293.pdf .

Rockett, K. E. (1990), "Choosing the Competition and Patent Licensing", *RAND Journal of Economics*, 21 pp. 161-171.

Scotchmer, S. (1991), "Standing on the Shoulders of Giants: Cumulative Research and the Patent Law", *Journal of Economic Perspectives* 5 (1991), pp. 29-41.

Shapiro, C. (2001a), "Navigating the Patent Thicket: Cross Licenses, Patent Pools, and Standard Setting", in Jaffe, A. B., J. Lerner and S. Stern (Eds.), *Innovation Policy and the Economy*, Vol. 1, MIT Press, pp. 119-150.

Shapiro, C. (2001b), "Antitrust Limits to Patent Settlements, Competition Policy Center", *Working Paper Series* CPC01-18, Competition Policy Center, Institute for Business and Economic Research, UC Berkeley.

Shephard, A. (1987), "Licensing to Enhance Demand for New Technologies", *RAND Journal of Economics* 18 (1987), pp. 360-368.

Teece, D. J. (1986), "Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy", *Research Policy* 15 (1986), pp. 285-305.

Von Hippel, E. (1994), "'Sticky Information' and the Locus of Problem Solving: Implications for Innovation", *Management Science*, 40(4), pp. 429-439.

Vonortas, N. and K. YounJung (2004), "Technology Licensing", *Patents, Innovation and Economic Performance*, OECD, Paris, pp.181-199.

Williamson, O. E. (1991), "Comparative Economic Organization - The Analysis of Discrete Structural Alternatives", *Administrative Science Quarterly* 36 (4), pp. 269-296.